

WHAT IS CLAIMED IS:

1 1. A system for restoring normal body temperature
2 to a patient, said system comprising:
3 an intravascular catheter having at least one heat
4 transfer surface;
5 a temperature sensor; and
6 a control unit connectable to the temperature sensor
7 and the catheter for selectively transferring heat to and from
8 the at least one heat transfer surface to maintain normal body
9 temperature.

1 2. A system as in claim 1, wherein the catheter
2 includes at least a heat-generating surface and a separate
3 heat-absorbing surface.

1 3. A system as in claim 2, wherein the heat-
2 generating surface comprises a resistance heater and the heat-
3 absorbing surface comprises a metal foil wrapped around the
4 catheter.

1 4. A system as in claim 3, wherein the resistance
2 heater comprises a coil and the metal foil has an exposed area
3 of at least 2 cm².

1 5. A system as in claim 4, wherein the control
2 unit comprises an electrical current source connectable to the
3 resistance heater and a thermoelectric cooler connectable to
4 the metal foil.

1 6. A system as in claim 1, wherein the catheter
2 includes at least one flow lumen which permits flow of a heat
3 exchange medium past the heat transfer surface, and wherein
4 the control unit includes a heater, a cooler, and a controller
5 for selectively activating the heater or the cooler to heat or
6 cool the heat exchange medium and restore normal body
7 temperature to the patient.

1 7. A system as in claim 6, wherein the heater is
2 an electrical resistance heater and the cooler is a
3 thermoelectric cooler.

1 8. A system as in claim 1, wherein the temperature
2 sensor is on the catheter and measures blood temperature.

1 9. A system as in claim 1, wherein the temperature
2 sensor is separately attachable to the patient to measure body
3 temperature.

1 10. A catheter for restoring normal body
2 temperature to a patient by selectively transferring heat to
3 or from blood flow, said catheter comprising:

4 a catheter body having a proximal end and a distal
5 end which is insertable into a blood vessel;

6 a heat-generating heat exchange surface near the
7 distal end of the catheter; and

8 a heat-absorbing heat exchange surface near the
9 distal end of the catheter.

1 11. A catheter as in claim 10, wherein the catheter
2 body has a length in the range from 15 cm to 50 cm and a
3 diameter in the range from 1 mm to 5 mm.

1 12. A catheter as in claim 10, wherein the heat-
2 generating heat transfer surface comprises an electrical
3 resistance heater and wherein the catheter further comprises a
4 connector which connects the electrical resistance heat to an
5 external current source.

1 13. A catheter as in claim 10, wherein the heat-
2 absorbing heat transfer surface comprises a metal foil wrapped
3 around the catheter body.

1 14. A catheter as in claim 13, wherein the metal
2 foil extends from near the distal end to near the proximal end
3 of the catheter body and wherein the proximal end of the foil
4 is configured to engage an external cooler.

1 15. A method for restoring normal body temperature
2 to a patient having a body temperature above or below normal
3 body temperature, said method comprising:

4 selectively introducing heat to the blood flow for
5 hypothermic patients or removing heat from the blood flow from
6 hyperthermic patients;

7 monitoring a temperature characteristic of the
8 patient; and

9 selectively removing heat through the catheter from
10 the blood flow of initially hypothermic patients if the
11 temperature characteristic indicates that the patient has or
12 will become hyperthermic or introducing heat through the
13 catheter to the blood flow of initially hyperthermic patients
14 if the temperature characteristic indicates that the patient
15 has or will become hypothermic.

1 16. A method as in claim 15, wherein the heat is
2 transferred via a catheter inserted into a blood vessel
3 selected from the group consisting of the femoral artery, the
4 jugular artery, and the jugular vein.

1 17. A method as in claim 15, wherein the heat
2 introducing steps comprise introducing heat at a rate between
3 10 W and 250 W.

1 18. A method as in claim 17, wherein the heat
2 introducing step comprises directing current through a
3 resistance heater near the distal end of the catheter, passing
4 radiofrequency current from the distal end of the catheter
5 through the blood, circulating a heated medium through a heat
6 exchanger near the distal end of the catheter, or directing
7 light energy through a wave guide to the distal end of the
8 catheter.

1 19. A method as in claim 15, wherein the heat
2 removing steps comprise removing heat at a rate between
3 1 W and 100 W..

1 20. A method as in claim 19, wherein the heat
2 removing step comprises (a) engaging a proximal end of the
3 catheter against a cooler in order to conductively remove heat
4 from a distal portion of the catheter along a heat conductive
5 path on the catheter and to the cooler or (b) circulating a
6 cooling fluid from the proximal end of the catheter, through a
7 distal portion of the catheter, and back to the proximal end.

1 21. A method as in claim 15, wherein the
2 temperature characteristic monitoring step comprises
3 monitoring at least one of body temperature and blood
4 temperature.

1 22. A method as in claim 15, wherein the surface
2 temperature of the heating surface is maintained below 42°C.

1 23. A method as in claim 15, wherein blood is being
2 heated, wherein heating is stopped when the blood temperature
3 reaches 36.9°C.

1 24. A method as in claim 15, wherein blood is being
2 cooled, wherein cooling is stopped when the blood temperature
3 drops to 36.9°C.